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AUTHOR Simner, Marvin L.
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ABSTRACT

A 3-year longitudinal investigation indicated that form errors in printing that children make can aid in the identification of at-risk or failure-prone pupils as early as the start of prekindergarten. Two samples were selected, one consisting of 104 and the other of 63 prekindergarten children. Mean age of the samples was 52 months. Item analysis was used to determine letters and numbers on the Printing Performance School Readiness Test (Simner, 1985) most predictive of later school failure. A total of 18 letters and numbers were selected and presented to subjects individually. Follow-up data assessing subjects' academic achievements were obtained at the end of first grade from marks in reading and arithmetic on report cards and scores on two standardized achievement tests: the word identification subtest from the Woodcock Reading Mastery Test (1974), and the addition, subtraction, numerical reasoning, word problem, and time subtests from the Keymath Diagnostic Arithmetic Test (Connolly, Nachtman, and Pritchett, 1971). Findings indicate that form errors in children's printing at the start of prekindergarten can be scored reliably, remain stable over time, and are closely linked to children's performance in first grade. (RH)

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Predicting First Grade Achievement from Form Errors in Printing at the Start of Pre-kindergarten

Marvin L. Simner, Ph.D.
Department of Psychology
University of Western Ontario
London, Ontario N6A 5C2

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Abstract

Form errors in printing involve the addition, deletion, or misalignment of parts leading to a marked distortion in the overall shape or form of a letter or number. Although typically viewed in the past as merely bothersome mistakes that interfere with legibility, recent findings indicate that an excessive number of form errors in a kindergarten child's printing can be an important warning sign of later school failure. The present three year longitudinal investigation extends these findings by showing that form errors also can be used to help identify an at-risk or failure-prone child even as early as the start of pre-kindergarten.

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Predicting First Grade Achievement from Form Errors in Printing at the Start of Pre-kindergarten

When preschool children print it is not unusual to find a letter such as the capital E containing four or more horizontal lines, an S drawn in the shape of a backward three, or Q appearing without a diagonal. These errors are known as form errors because they involve the addition, deletion, or misalignment of parts thereby producing a distortion in the overall shape or form of the intended letter or number (see Figure 1 for other examples).

In the past errors of this nature generated very little interest among educators and psychologists except for those who were concerned with developing instructional procedures to improve legibility. Recently, though, we discovered that an excessive number of form errors in a kindergarten child's printing can be an important early warning sign of later school failure (Simner, 1982). Incorporating procedures derived from this work we then developed the Printing Performance School Readiness Test (PPSRT) to provide a standardized means for identifying kindergarten children who exhibit this warning sign (Simner, 1985a). While the PPSRT is quite appropriate for use at the kindergarten level, unfortunately, the task is too long and too demanding to employ with younger children. Hence, the present longitudinal investigation was undertaken to determine if form errors, measured using a shorter, less taxing version of the PPSRT, can be employed as effectively at the start of pre-kindergarten as they can during the kindergarten year to help identify the failure-prone child.

Place Figure 1 about here

Method

Two samples of children were employed. Sample #1 contained 104 pre-kindergarten children (60 males, 44 females) tested in October/November, 1983. Sample #2 consisted of 63 pre-kindergarten children (35 male, 28 female) tested in October/November, 1984. Detailed information describing the procedure used to obtain the children and the population from which both samples were drawn can be found in Simner (1987a). The mean age of the children at the time testing took place was 52 months (SD = 2.9).

Test Instrument

To select as few letters and numbers as possible with which to construct an effective yet shorter or abbreviated version of the PPSRT, we followed recommendations by Anastasi (1982, pp. 203-210) and performed an item analysis on results from our earlier investigations at the kindergarten level in which all 41 letters and numbers in the full scale PPSRT were employed. The aim of this analysis was to determine which letters and numbers were most predictive of later school failure. Based on the outcome of this work 18 letters and numbers were chosen and presented to the pre-kindergarten children on two 8.5 in. x 11 in. response sheets using the fixed but random order illustrated in Figure 2.

Place Figure 2 about here

Test Procedure

The children, tested one at a time, were asked to copy each letter and number in the spaces provided below the letters and numbers on the response sheets. No time limit was employed, however, all of the children completed the task in less than three minutes. The resulting protocols were scored for the presence of form errors according to the instructions in the PPSRT manual. Because each of the children's attempts at reproducing a letter or number received a score of 0 (form error absent) or 1 (form error present), total scores ranged from 0 through 18.

Inter-rater and Test-retest Reliability

To evaluate inter-rater reliability, all of the protocols from Sample #1 were scored independently by two people. The results yielded a product-moment correlation of .95 ($df = 102$, $p < .001$). Furthermore, the total scores generated by both raters differed by three points or less in 90% of the cases.

Test-retest reliability was evaluated by having a different tester who was unaware of the children's previous performances, give the abbreviated PPSRT to 44 randomly selected children from Sample #2 on a second occasion one month later. Here the product-moment correlation was .87 ($df = 42$, $p < .001$) and the total scores on each occasion differed by three points or less in 78% of the cases. Together, these findings agree with the evidence we obtained using the full-scale PPSRT.

Follow-Up Procedures

As in our earlier work, both samples were followed for three years. To assess the children's academic achievements at the end of this period and to permit a direct comparison between the

present findings and our previous results, we employed the same sets of criteria used in our earlier investigations. The first set made use of the children's report card marks in reading and arithmetic issued in June of first grade. These marks ranged on a 12 point scale from D- to A+ and reflected the teacher's judgements of the children's command of the core curriculum established by the Board of Education.

The second set of criteria consisted of the children's scores at the end of first grade on two standardized achievement tests. Here we employed, as before, the word identification subtest from the Woodcock Reading Mastery Test (WRMT) by Woodcock (1974) along with the addition, subtraction, numerical reasoning, word problem, and time subtests from the Keymath Diagnostic Arithmetic Test (KDAT) by Connolly, Nachtman, and Pritchett (1971).

Results and Discussion

Table 1 contains, for Sample #1 and Sample #2, the product-moment correlations between the children's total scores on the abbreviated PPSRT and the children's performances, three years later, on the two criteria. As the evidence in this table shows, when in-class performance was the criterion the correlations ranged from -.42 through -.58 and when the criterion was achievement test performance the correlations extended from -.40 through -.60[1] . Hence, the predictive validity correlations obtained from both samples are also in line with the predictive validity correlations that we obtained earlier using the full scale PPSRT. In that work, the samples of kindergarten children followed through the end of first grade produced scores on the full scale PPSRT which correlated from -.40 to -.75 with the two achievement tests and

from -.43 to -.56 with the two measures of classroom performance (see Table 1 in Simner, 1986).

Place Table 1 about here

Next we asked if scores on the abbreviated PPSRT could be used with the same accuracy as scores on the full scale PPSRT to identify individual children who later had serious learning problems. In our previous work the cutoff on the full scale PPSRT correctly identified, on average, 81% of those kindergarten children who subsequently experienced considerable difficulty mastering the curriculum (true positives) while, at the same time, achieving an average false positive rate of 23%.

To compare these previous findings with the present data we employed our earlier procedure and chose as a cutoff on the abbreviated PPSRT a score which corresponded to somewhat less than 1 SD above the mean for Sample #1 ($M = 11.80$, $SD = 5.33$) and Sample #2 ($M = 11.80$, $SD = 5.27$), respectively. This procedure resulted in a score of 16 form errors as the cutoff in each sample. Also as before, the children were divided into two categories reflecting the teacher's end-of-year overall evaluations of the children's command of the curriculum. Children whom we placed in the "poor performance" category were the ones who either failed, were promoted to a slower or junior section of the next grade, or were recommended for some type of special education class. The second category labelled "good performance" contained children who received an overall rating of B- to A+ on their report cards at the end of first grade. According to the children's teachers, these

ratings were only awarded to children who were not experiencing any major problem with the core curriculum.

Table 2 contains the number and percentage of pre-kindergarten children in Sample #1 and #2 who were placed either in the poor performance or in the good performance category and whose scores on the abbreviated PPSRT were either above or below the cutoff of 16 form errors. Once again the findings were very similar in both samples and were nearly identical to the results that we obtained previously. Specifically, with this cutoff we correctly identified 70% to 80% of the children in the poor performance category (true positives) while achieving, on average, a false positive rate of 19%[2].

Place Table 2 about here

In short, the outcome of this three year longitudinal investigation demonstrates that form errors in children's printing at the start of pre-kindergarten can be scored reliability, remain stable over time, and are closely tied to children's performances in first grade. Hence, the present results are not only similar in all respects to the findings that we obtained in our earlier work at the kindergarten level, they also extend our earlier results by showing that form errors in printing can provide important information about a child's learning potential as much as two years before a child even enters school[3].

Table 1. Product-moment correlations between children's scores on the abbreviated PPSRT administered in the fall of pre-kindergarten and children's subsequent academic performances at the end of first grade.

	June Report Card Marks		Achievement Test Performance	
	reading	arithmetic	WRMT[1]	KDAT[2]
Sample #1	-.42***	-.44***	-.40***	-.49***
Sample #2	-.58***	-.51***	-.57***	-.60***

*** $p < .001$

[1]Woodcock Reading Mastery Test

[2]Keymath Diagnostic Arithmetic Test

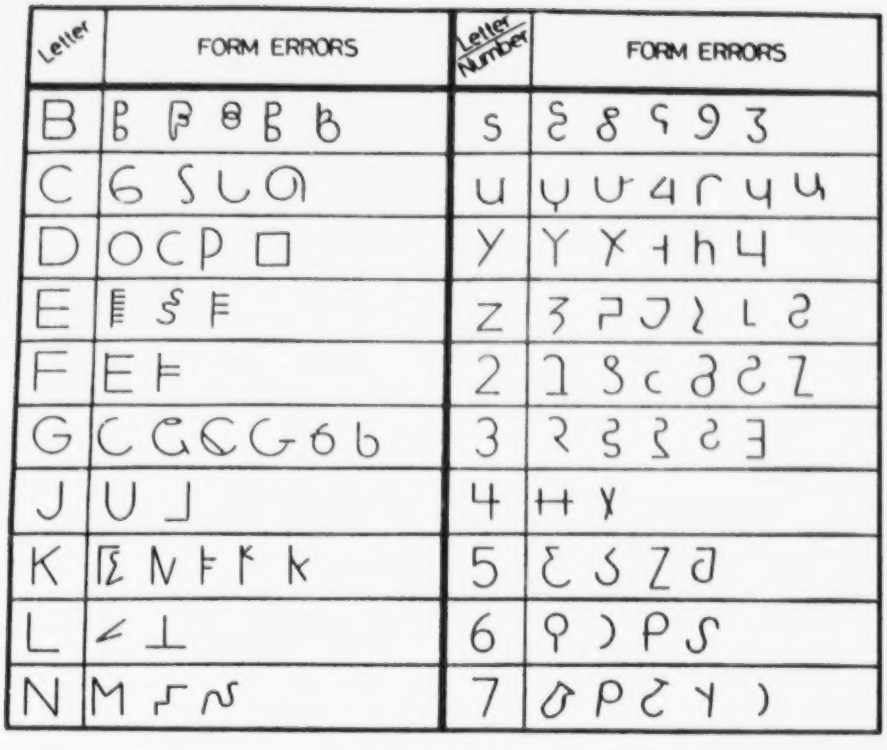
Table 2. Prediction of children's classroom performance evaluations from the cutoff score on the abbreviated PPSRT administered in the fall of pre-kindergarten.

Sample #1

	poor performance (true positive)	good performance (false positive)
Poor Prognosis (16 errors or more)	14 (70%)	8 (18%)
	(false negative)	(true negative)
Good Prognosis (15 errors or less)	6 (30%)	37 (82%)

Sample #2

	poor performance (true positive)	good performance (false positive)
Poor Prognosis (16 errors or more)	4 (80%)	9 (20%)
	(false negative)	(true negative)
Good Prognosis (15 errors or less)	1 (20%)	35 (80%)



Letter	FORM ERRORS	Letter Number	FORM ERRORS
B		5	
C		4	
D		Y	
E		Z	
F		2	
G		3	
J		4	
K		5	
L		6	
N		7	

Figure 1. Examples of form errors in children's printing (from Simner, 1982, reproduced with permission granted by the editor-in-chief of the Journal of Learning Disabilities).

RESPONSE SHEET 1

RESPONSE SHEET 2

Figure 2. Response sheets comprising the abbreviated PPSRT.

Footnotes

[1]Separate correlations were calculated for the males and females in each sample, but no reliable sex differences were found.

[2]It is worth noting that the findings in both Table 1 and Table 2 also compare quite favorably to the findings obtained with many other far more time consuming screening devices such as the DIAL, the Minnesota Preschool Inventory, and the Developmental Test of Visual Motor Integration, to mention but a few (see Lichtenstein and Ireton (1984) and Simner (1983) for reviews). If the abbreviated PPSRT is to be employed as a cost-effective alternative to these other devices, however, it would be well to keep in mind the various precautions and recommendations for use that we mentioned previously not only with regard to the full scale PPSRT (Simner, 1985a) but also with regard to several other brief screening procedures that we developed (Simner, 1985b, 1987b).

[3]Some possible reasons for the relationship between form errors and school achievement are given in Simner, 1982, 1985a, and 1986. Recommendations for assisting children who produce an excessive number of these errors also can be found in these sources.

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